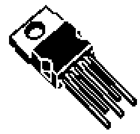
VN540-E / VN540SP-E
VN540-12-E

SINGLE HIGH SIDE SMART POWER SOLID STATE RELAY

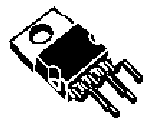
General Features

Type	V_{demag}	R_{DSon}	I_{out}	V_{CC}
VN540-E VN540SP-E VN540-12-E	V_{CC}-55V	50mΩ	2.8A	36V

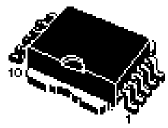
- OUTPUT CURRENT (CONTINUOUS) : 2.8A
- DIGITAL INPUT CLAMPED AT 32V
- PROTECTION AGAINST:
  - LOSS OF GROUND
  - SHORTED LOAD AND OVER-TEMPERATURE
- BUILT-IN CURRENT LIMITER
- UNDERVOLTAGE SHUT-DOWN
- OPEN DRAIN DIAGNOSTIC OUTPUT
- FAST DEMAGNETIZATION OF INDUCTIVE LOADS



PENTAWATT(012Y)



PENTAWATT



PowerSO-10™

Description

The VN540-E, VN540SP-E, VN540-12-E are monolithic devices designed in STMicroelectronics VIPower technology, intended for driving resistive or inductive loads with one side connected to ground. Active current limitation avoids the system power supply dropping in case of shorted load. Built-in thermal shut-down protects the chip from overtemperature. The open drain diagnostic output indicates over-temperature conditions.

Block Diagram

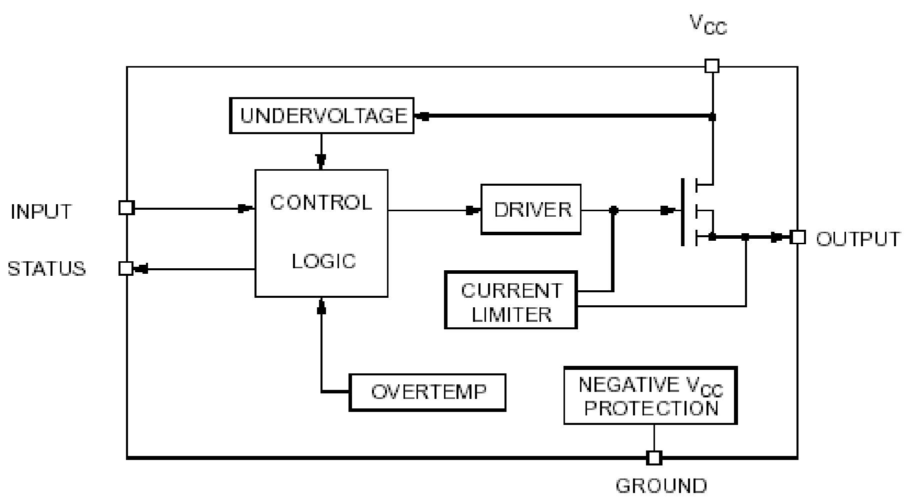


Table 1. Absolute Maximum Rating

Symbol	Parameter	Value	Unit
V_{CC}	Power supply voltage	45	V
$-V_{CC}$	Reverse supply voltage	-4.0	V
I_{OUT}	Maximum DC load current	Internally limited	A
I_R	Reverse output current	-10	A
I_{IN}	Input current	± 10	mA
I_{STAT}	Status pin current	± 10	mA
V_{ESD}	Electrostatic discharge (R = 1.5KW; C = 100pF)	2000	V
P_{TOT}	Power dissipation at T_c = 25°C	Internally limited	w
T_J	Junction operating temperature	Internally limited	°C
T_{STG}	Storage Temperature	-55 to 150	°C
E_{AS}	Single pulse avalanche energy	500	

Figure 1. Connection Diagram (Top View)

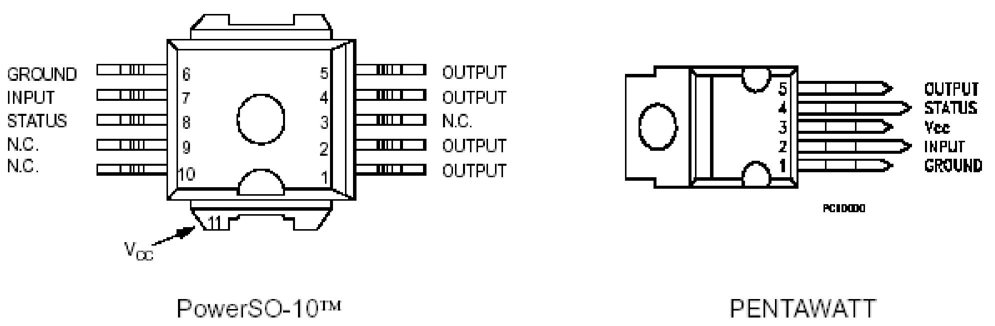


Figure 2. Current and Voltage Conventions

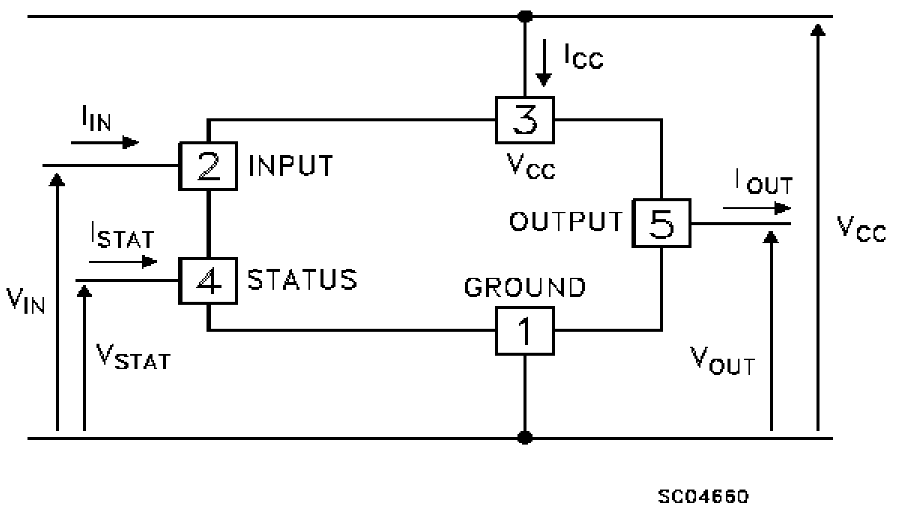


Table 2. Thermal data

Symbol	Parameter		Value		Unit
			PowerSO-10	Pentawatt	
R_{thJC}	Thermal resistance junction-case	Max	1.5	2.0	°C/W
R_{thJA}	Thermal resistance junction-ambient	Max	50	60	°C/W

Electrical Chracteristics (10V < V_{CC} < 36V; -25°C < T_J < 85°C; unless otherwise specified)

Table 3. Power Section

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage		10		36	V
R_{ON}	On state resistance	I_{OUT} = 2.8A; T_J = 25°C I_{OUT} = 2.8A;			50 90	mΩ mΩ
I_S	Supply current	OFF state ON state; T_J = 125°C I_{OUT} = 0A			1 3	mA mA
I_{LS}	Output leakage current	Channel OFF V_{CC} = 45V			100	µA
I_{LGND}	Output current at turn-off	$V_{CC} = V_{IN} = V_{GND} = V_{STAT}$ = 24V T_J= - 25°C < T_J < 100°C			2	mA
V_{OL}	Low state output voltage	$V_{IN} = V_{IL;}$ R_{LOAD} >= 10MΩ			1.5	V
V_{demag}	Output voltage at turn-off	I_{OUT} = 2.8A; L_{LOAD} >= 1mH	V_{CC}-65	V_{CC}-55	V_{CC}-45	V

Table 4. Switching

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(ON)}$	Turn-on delay on output current	I_{OUT} = 2.8A, Resistive Load Input rise time < 0.1µs, V_{CC} = 24V; T_J = 25°C		40		µs
t_r	Rise time of output current	I_{OUT} = 2.8A, Resistive Load Input rise time < 0.1µs, V_{CC} = 24V; T_J = 25°C		60		µs
$t_{d(OFF)}$	Turn-off delay time of output current	I_{OUT} = 2.8A, Resistive Load Input rise time < 0.1µs, V_{CC} = 24V; T_J = 25°C		60		µs
t_f	Fall time of Output current	I_{OUT} = 2.8A, Resistive Load Input rise time < 0.1µs, V_{CC} = 24V; T_J = 25°C		25		µs
$dI/dt_{(on)}$	Turn-on current average slope	I_{OUT} = 2.8A, $I_{OUT} = I_{LIM}$; 25°C < T_J < 140°C			0.5 2	A/µs
$dI/dt_{(off)}$	Turn-off current average slope	I_{OUT} = 2.8A, $I_{OUT} = I_{LIM}$; 25°C < T_J < 140°C			2 4	A/µs

Table 5. Logical Input

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{IL}	Input low level voltage				2.0	V
V_{IH}	Input high level voltage		3.5			V
$V_{I(HYST)}$	Input hysteresis voltage			0.5		V
I_{IN}	Input current	V_{IN} = 30V V_{IN} = 2.0V	 25		300	µA µA
V_{ICL}	I/O Input clamp voltage *Note 1*	I_{IN} = 1mA I_{IN} = -1mA	32	36 -0.7		V V

Note: 1 *The input voltage is internally clamped at 32V minimum, it is possible to connect the input pins to an higher voltage via an external resistor calculate to not exeed 10mA*

Table 6. Protection and Diagnostic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{STAT}	Status output voltage	I_{STAT} = 5mA (Fault condition)			1	V
$V_{SCL(*)}$	Status clamp voltage	I_{STAT} = 1mA I_{STAT} = -1mA	32	36 -0.7		V V
I_{STAT}	Leakage on diagnostic pin in high state	V_{STAT} = 5V			10	µA
V_{USD}	Undervoltage shut down		5.0		8.0	V
I_{LIM}	DC Short circuit current	V_{CC} = 24V; R_{LOAD} < 10mΩ	2.8	5.0	8.0	A
I_{OVPK}	Peak short circuit current	V_{CC} = 24V; V_{IN} = 30; R_{LOAD} < 10mΩ			4	A
t_{SC}	Delay time of current limiter				100	µs
T_{TSD}	Thermal shut down temperature		150	170		°C
T_R	Thermal reset temperature		135	155		°C

(*)Status determination > 100ms after the switching edge.

Figure 3. Switching Characteristics

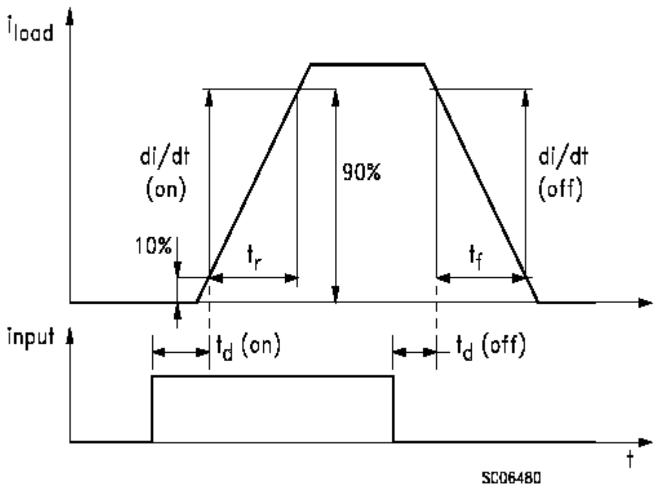


Table 7. Truth Table

	INPUT	OUTPUT	STATUS
Normal operation	L H	L H	H H
Overtemperature	L H	L L	H L
Undervoltage	L H	L L	H H
Shorted load (Current limitation)	L H	L H	H H

Figure 4. Peak Short Test Circuit

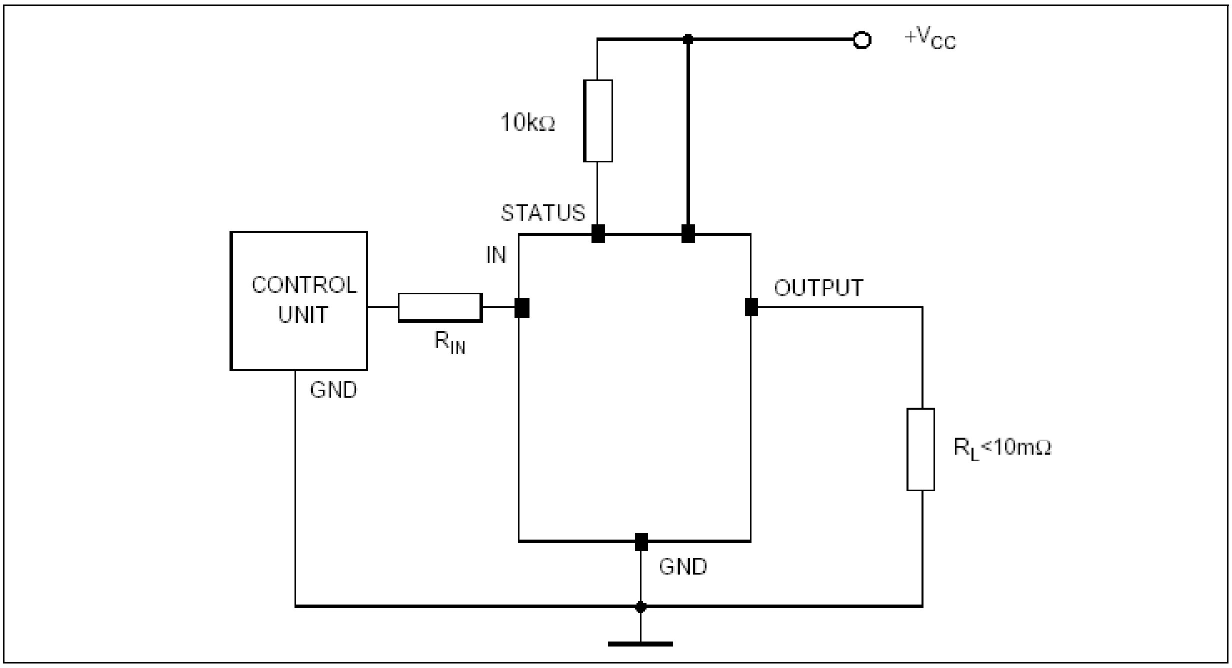


Figure 5. Switching Waveforms

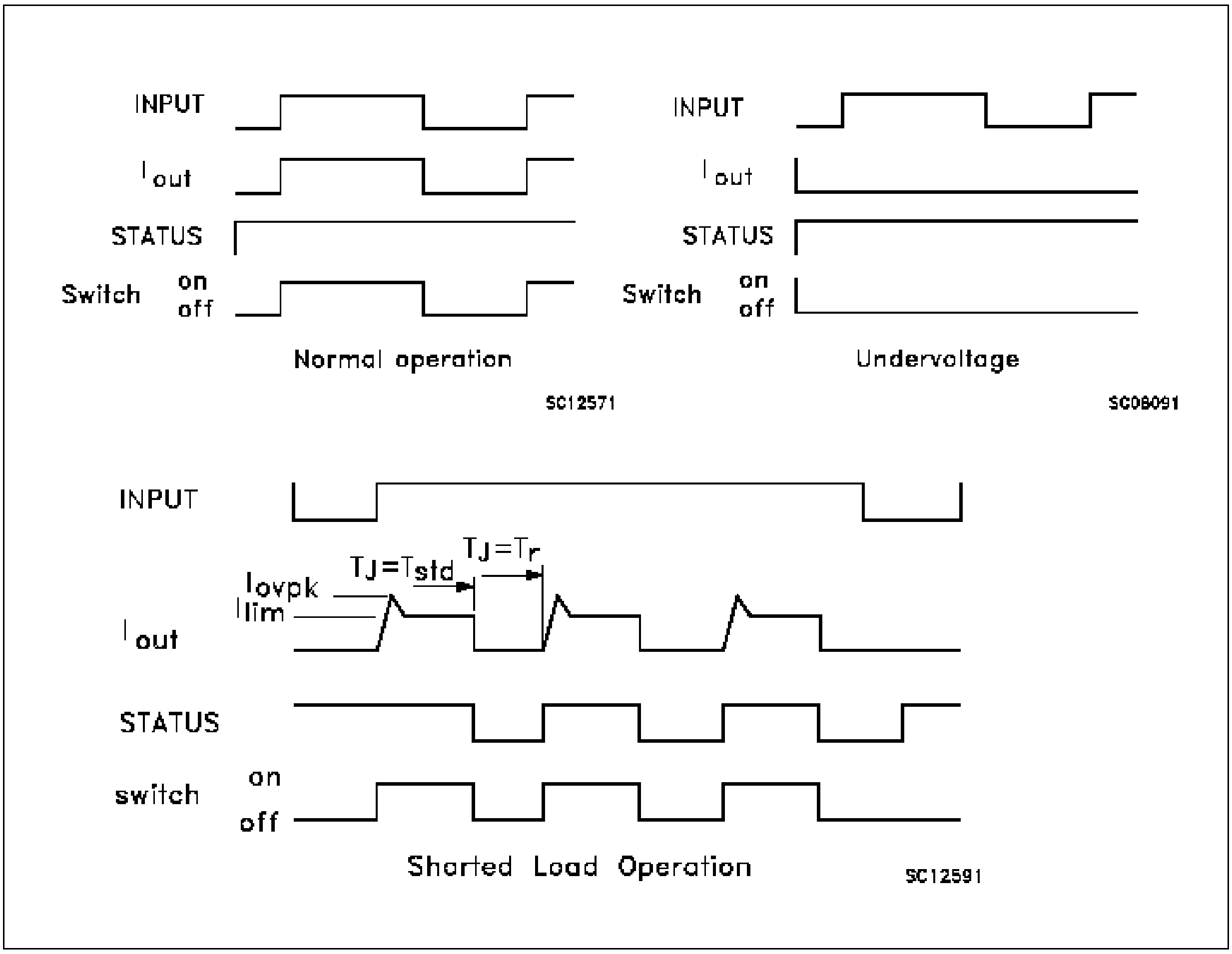
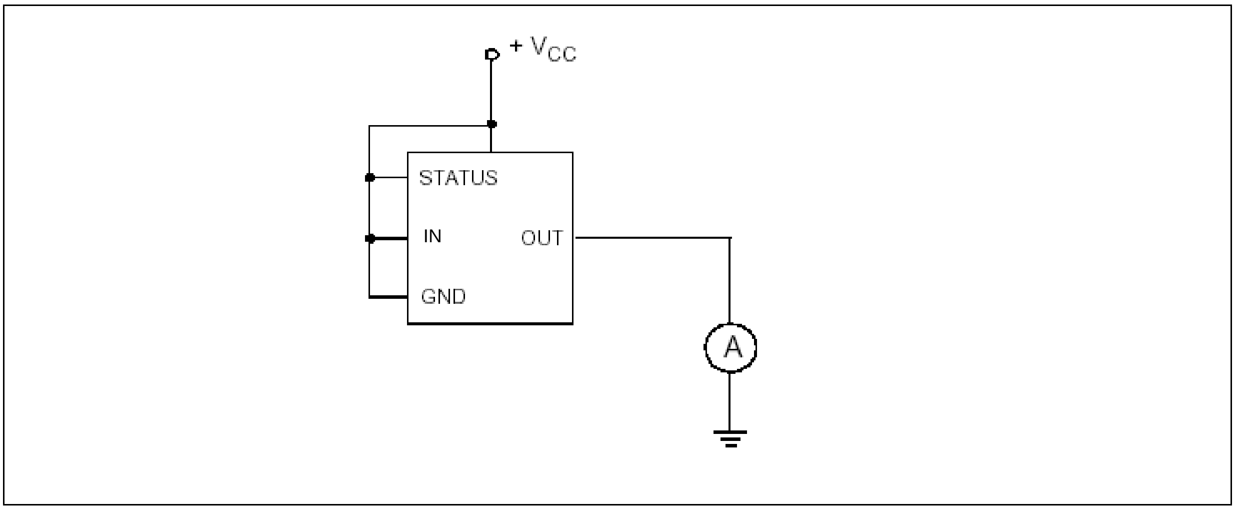


Figure 6. I_{LGND} Test Configuration

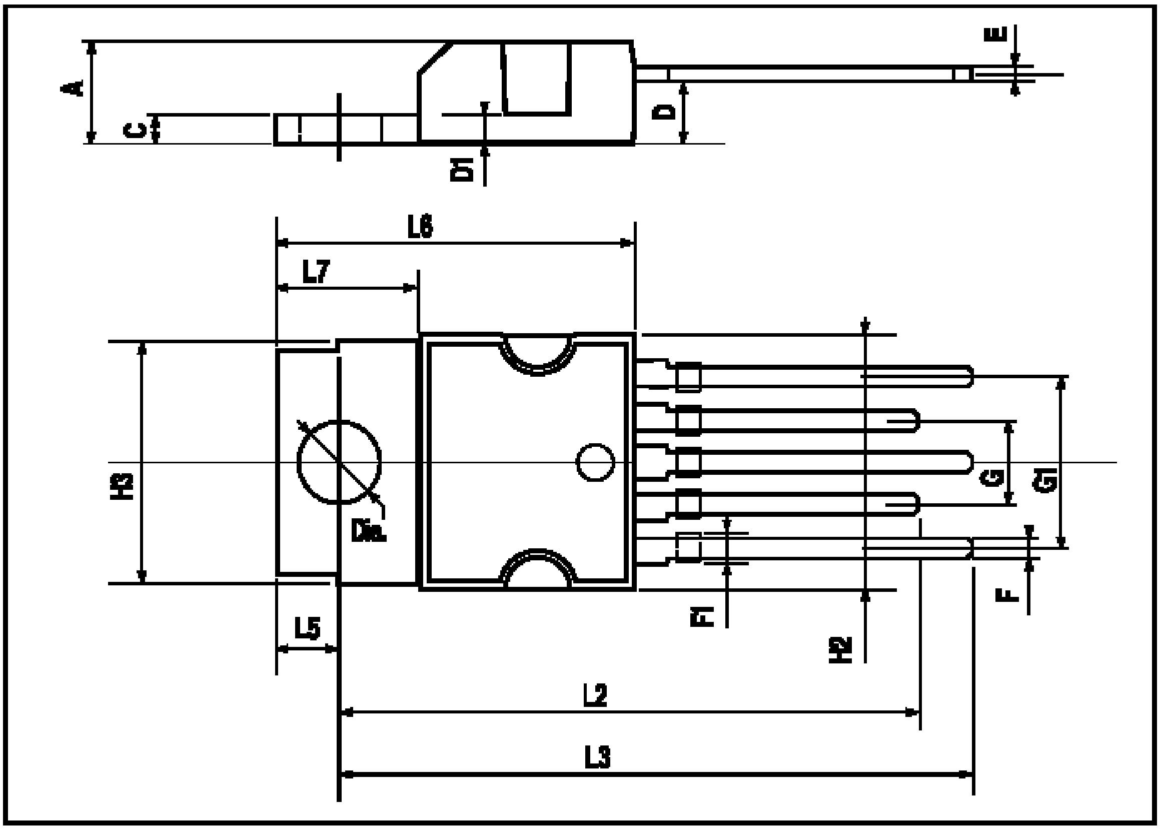


Package Mechanical Data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

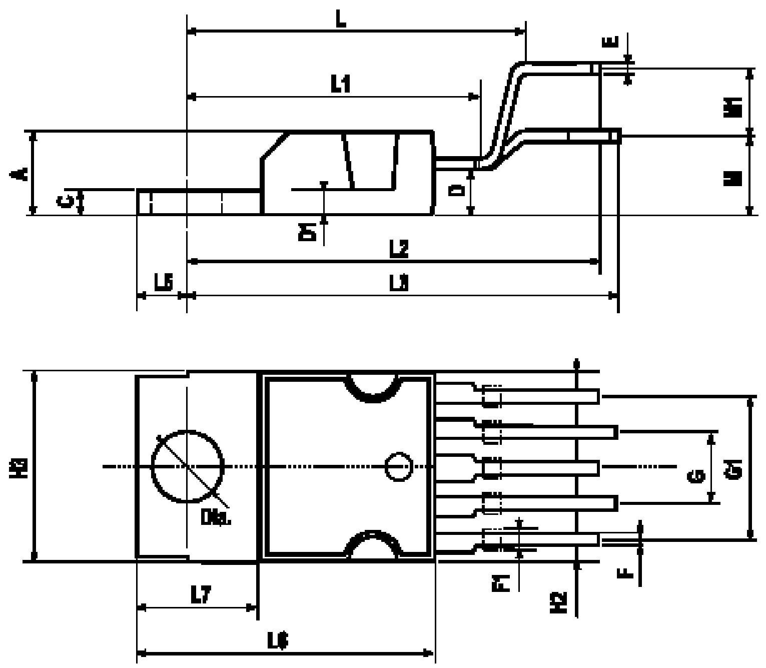
PENTAWATT (IN-LINE) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			4.8			0.189
C			1.37			0.054
D	2.4		2.8	0.094		0.110
D1	1.2		1.35	0.047		0.053
E	0.35		0.55	0.014		0.022
F	0.8		1.05	0.031		0.041
F1	1		1.4	0.039		0.055
G	3.2	3.4	3.6	0.126	0.134	0.142
G1	6.6	6.8	7	0.260	0.268	0.276
H2			10.4			0.409
H3	10.05		10.4	0.396		0.409
L2	23.05	23.4	23.8	0.907	0.921	0.937
L3	25.3	25.65	26.1	0.996	1.010	1.028
L5	2.6		3	0.102		0.118
L6	15.1		15.8	0.594		0.622
L7	6		6.6	0.236		0.260
Diam.	3.65		3.85	0.144		0.152



PENTAWATT (VERTICAL) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			4.8			0.189
C			1.37			0.054
D	2.4		2.8	0.094		0.110
D1	1.2		1.35	0.047		0.053
E	0.35		0.55	0.014		0.022
F	0.8		1.05	0.031		0.041
F1	1		1.4	0.039		0.055
G	3.2	3.4	3.6	0.126	0.134	0.142
G1	6.6	6.8	7	0.260	0.268	0.276
H2			10.4			0.409
H3	10.05		10.4	0.396		0.409
L		17.85			0.703	
L1		15.75			0.620	
L2		21.4			0.843	
L3		22.5			0.886	
L5	2.6		3	0.102		0.118
L6	15.1		15.8	0.594		0.622
L7	6		6.6	0.236		0.260
M		4.5			0.177	
M1		4			0.157	
Diam.	3.65		3.85	0.144		0.152



PowerSO-10™ MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	3.35		3.65	0.132		0.144
A (*)	3.4		3.6	0.134		0.142
A1	0.00		0.10	0.000		0.004
B	0.40		0.60	0.016		0.024
B (*)	0.37		0.53	0.014		0.021
C	0.35		0.55	0.013		0.022
C (*)	0.23		0.32	0.009		0.0126
D	9.40		9.60	0.370		0.378
D1	7.40		7.60	0.291		0.300
E	9.30		9.50	0.366		0.374
E2	7.20		7.60	0.283		300
E2 (*)	7.30		7.50	0.287		0.295
E4	5.90		6.10	0.232		0.240
E4 (*)	5.90		6.30	0.232		0.248
e		1.27			0.050	
F	1.25		1.35	0.049		0.053
F (*)	1.20		1.40	0.047		0.055
H	13.80		14.40	0.543		0.567
H (*)	13.85		14.35	0.545		0.565
h		0.50			0.002	
L	1.20		1.80	0.047		0.070
L (*)	0.80		1.10	0.031		0.043
α	0º		8º	0º		8º
α (*)	2º		8º	2º		8º

(*) Muar only POA P013P

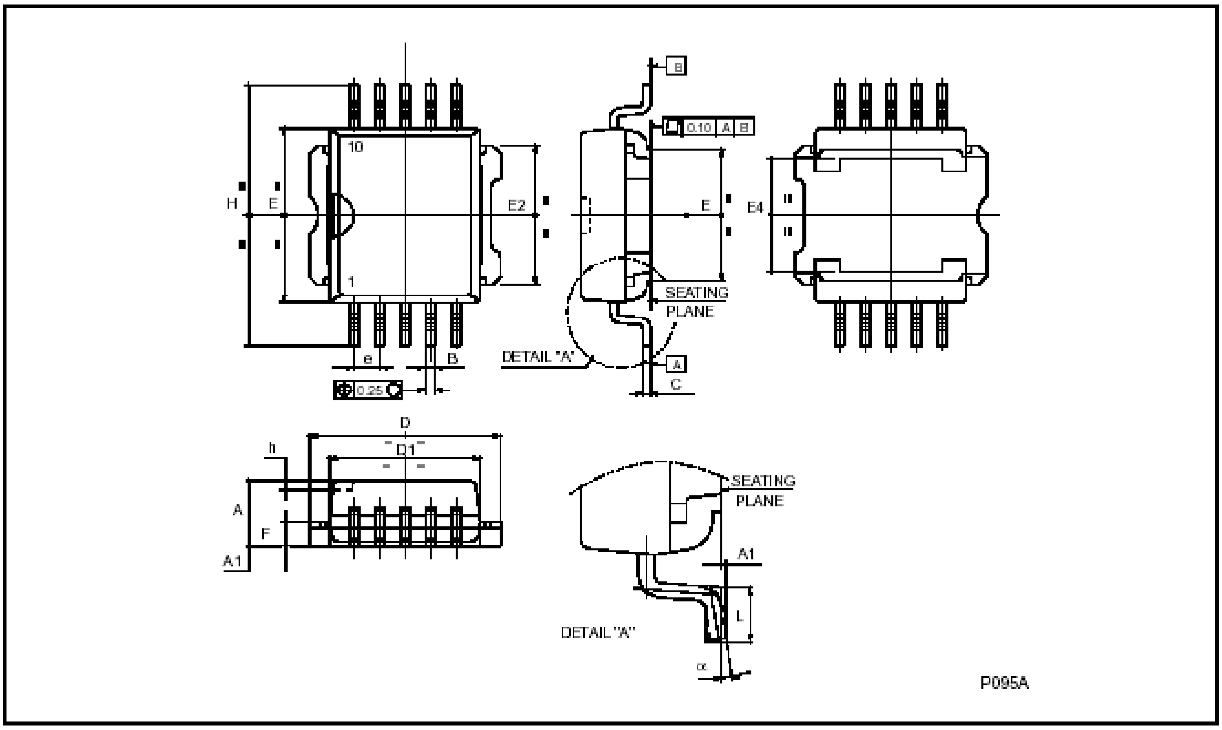


Table 8. Order Codes

Package	Tube	Tape and Reel
PowerSO-10™	VN540SP-E	VN540SPTR-E
PENTAWATT vertical	VN540-E	
PENTAWATT straight	VN540-12-E	

Table 9. Revision History

Date	Revision	Changes
2-Nov-2005	1	Initial release